OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **LAKE WINNISQUAM (Three Islands, Pot Island, and Mohawk Island),** the program coordinators have made the following observations and recommendations:

The **Pot Island** monitoring group sampled the central deep spot and tributaries two times this summer. We know that due to weather and scheduling issues, it was difficult for this group to sample three times this season. Typically, this group samples three times each season. As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality.

The **Three Island** and **Mohawk Island** monitoring groups sampled the northern and southern deep spots, respectively, once this summer. We would like to thank the group for sampling **once** this summer. However, we encourage these monitoring groups to sample **additional** times each summer. Typically we recommend that monitoring groups sample **three times** per summer (once in **June**, **July**, and **August**). We understand that the number of sampling events each group decides to conduct per summer will depend upon volunteer availability, and the monitoring group's water monitoring goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the lake at least once per month over the course of the season. If either group is having difficulty finding volunteers to help sample, or to pick-up or drop-off equipment at one of the laboratories, please give the VLAP Coordinator a call and we will try to work out an arrangement.

Ahern State Park, Laconia:
On December 10, 2002, Department of Environmental Services (DES) personnel met with the City of Laconia and the Ahern State Park Advisory Committee to discuss the water quality at Ahern State Park Beach. As a result of that meeting, DES developed and carried out a water quality monitoring plan for Ahern State Park, both at the beach area and in the Governor Park Stream watershed in Summer 2003. The

purpose of the monitoring was to identify and quantify sources of *E. coli* bacteria to the beach area.

During the Summer of 2003, DES conducted a sanitary survey of the Governor Park Stream watershed. In addition, DES conducted multiple rounds of dry weather and wet weather sampling. Potential bacteria sources were identified, documented, and mapped.

It was determined that sources of *E. coli* bacteria originating from the Lakes Region Correctional Facility grounds is the probable cause of water quality standard violations at Ahern State Park Beach and in Governor Park Stream during and immediately after stormwater runoff events. The primary suspected source is leakage and exfiltration from old clay sewer pipes.

In 2005, DES, DOC and the Department of Resources and Economic Development (DRED) agreed to a beach advisory plan that allowed beach advisory postings to occur based upon the site-specific relationship of rainfall and bacteria loading at the beach. A rain gage was installed at the DES Air Monitoring Station located at the DOC Lakes Region Facility. Following a 0.25 inch rainfall event, an email notification was automatically generated and distributed to DES, DOC, and DRED. Beach advisories were then posted by DRED at the site and by DES on the Beach Program website. Approximately 20 beach advisories were posted from May 1 through September 30, 2005.

In April 2005, the U.S. Environmental Protection Agency (EPA) issued an Administrative Order (AO) to DOC for the discharge of pollutants to Governor Park Stream without a National Pollution Discharge Elimination System (NPDES) permit. The AO required DOC to develop and implement an EPA-approved plan for identifying and eliminating the sources of unauthorized pollutants that discharge into Governor Park Stream. DOC hired Hoyle, Tanner and Associates, Inc. (HTA) to assist with fulfilling the requirements of the AO. HTA completed their investigation and issued a summary report in November 2005 which recommended additional sampling and testing, including DNA testing to determine the origin source of the bacteria and several sanitary and storm water system repairs.

There will be four herbicide treatments conducted at the lake in June 2006. The Winnisquam Lake Association received a matching grant from DES to treat the north section of the lake and Jay's Marina. Winnisquam Marine also received a matching grant to treat a small area around their dock area. Another matching grant will fund the treatment of the Sunray Shore, Belmont, area of the lake.

There are also plans for the Department of Transportation to reconfigure and pave a portion of Route 3 in Belmont. This is Phase II of the roadway improvement project that will continue where Phase I ended and will provide roadwork past the Belknap shopping mall. The new project will also examine the Route 3 runoff and provide best management practices to treat stormwater runoff before it enters the lake.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** Figure 1 (Appendix A) shows the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake has been monitored through VLAP.

  Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m^3.**

  Three Island Deep Spot
  The current year data (the top graph) show that the chlorophyll-a concentration on the **August** sampling event was ***slightly less than*** the state median and was ***greater than*** the similar lake median (for more information on the similar lake median, refer to Appendix F).

  Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has ***not significantly changed*** since monitoring began. Specifically, the chlorophyll-a concentration has ***fluctuated between approximately 1.6 and 4.2 mg/m^3*** since **1987**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.) It is important to point out that visual inspection of the historic trend line indicates a ***slightly increasing (meaning slightly worsening)*** chlorophyll trend. If the chlorophyll concentration continues to increase during future sampling seasons, the worsening trend will become statistically significant.

  Pot Island Deep Spot
  The current year data (the top graph) show that the chlorophyll-a concentration ***increased*** from **July** to **August**.

The historical data (the bottom graph) show that the 2005 chlorophyll-a mean is ***less than*** the state median and is ***greater than*** the similar lake median (for more information on the similar lake median, refer to Appendix F).

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has ***not significantly changed*** since monitoring began. Specifically, the chlorophyll-a concentration has ***fluctuated between approximately 1.2 and 3.9 mg/m^3,*** and has ***not continually increased or decreased*** since **1987.** (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

Mohawk Island Deep Spot

The current year data (the top graph) show that the chlorophyll-a concentration on the **September** sampling event was ***approximately equal to*** the state median and was ***greater than*** the similar lake median (for more information on the similar lake median, refer to Appendix F).

It is important to point out that visual inspection of the historic trend line indicates a ***slightly increasing (meaning slightly worsening)*** chlorophyll trend since monitoring began in **1987**. Please note that this deep spot was not sampled for phosphorus during 1999 or 2004, therefore, it was not possible to conduct a formal regression analysis of the historic transparency data. After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

While algae are naturally present in all lakes, an excessive or increasing amount of any type is not welcomed. In freshwater lakes, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase (such as sediment phosphorus releases, known as internal loading). Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about activities within the watershed that affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** Figure 2 (Appendix A) shows the historical and current year data for lake transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake has been monitored through VLAP.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

Three Island Deep Spot

The current year data (the top graph) show that the in-lake transparency on the August sampling event was ***greater than*** the state median and was ***slightly less than*** the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, visual inspection of the historical data trend line (the bottom graph) shows an ***increasing (meaning improving)*** trend for in-lake transparency since monitoring began in **1987.** Please note that this deep spot was not sampled for transparency during 1999, therefore, it was not possible to conduct a formal regression analysis of the historic transparency data. After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Pot Island Deep Spot

The current year data (the top graph) show that the in-lake transparency ***remained stable*** from **July** to **August**.

The historical data (the bottom graph) show that the 2005 mean transparency is ***greater than*** the state median and is ***slightly less than*** the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, the statistical analysis of the historical data shows that the mean annual in-lake transparency has ***significantly increased*** since monitoring began. Specifically, the transparency has ***increased*** (meaning ***improved***) on average by ***approximately 0.7 %*** per sampling season during the sampling period **1987** to **2005**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

Mohawk Island Deep Spot

The current year data (the top graph) show that the in-lake transparency on the **September** sampling event was ***greater than*** the state median and was ***less than*** the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***variable, but overall increasing (meaning improving)***, trend for in-lake transparency since monitoring began in **1987.** Please note that this deep spot was not sampled for transparency during 1999 or 2004, therefore, it was not possible to conduct a formal regression analysis of the historic transparency data. As previously discussed, after 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes sediment erosion to flow into lakes and streams, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, lake shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has joined VLAP.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Excessive phosphorus in a lake can lead to increased plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

<u>Three Island Deep Spot</u>
The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration on the ***August*** sampling event was ***less than*** the state median and was ***approximately equal to*** the similar lake median (refer to Appendix F for more information about the similar lake median).

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration on the August sampling event was ***less than*** the state median and ***greater than*** the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the epilimnion (upper layer) has ***not significantly changed*** since monitoring began. Specifically, the epilimnetic phosphorus concentration has ***fluctuated between approximately 2 and 13 ug/L*** and has ***not continually increased or decreased*** since **1987**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the hypolimnion (lower layer) has ***significantly decrease*****d** since monitoring began. Specifically, the phosphorus concentration in the hypolimnion has ***decreased*** (meaning ***improved***) on average by ***approximately 5.5%*** per sampling season during the sampling period **1987** to **2005**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

<u>Pot Island Deep Spot</u>

The current year data for the epilimnion (the top inset graph) and the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***increased*** from **July** to **August**.

The historical data show that the 2005 mean epilimnetic and hypolimnetic phosphorus concentration are ***less than*** the state median and are ***slightly greater than*** the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the epilimnion (upper layer) has ***significantly decrease*****d** since monitoring began. Specifically, the epilimnetic phosphorus concentration has ***decreased*** (meaning ***improved***) on average by ***approximately 1.7 %*** per sampling season during the sampling period **1987** to **2005**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the hypolimnion (lower layer) has ***not significantly changed*** since monitoring began. Specifically, the hypolimnetic phosphorus concentration has ***fluctuated between approximately 5 and 15.5 ug/L,*** and has ***not continually increased or decreased*** since **1987**.

Mohawk Island Deep Spot

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration on the September sampling event was ***less than*** the state median and was ***slightly greater than*** the similar lake median (refer to Appendix F for more information about the similar lake median).

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration on the **September** sampling event was ***much greater than*** the state median and similar lake median (refer to Appendix F for more information about the similar lake median). However, it is important to point out that the turbidity of the hypolimnetic sample was ***elevated*** **(2.02 NTUs)** on the **September** sampling event. This suggests that the lake bottom was disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed. When the lake bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

Overall, the historical data shows that the phosphorus concentration in the epilimnion (upper layer) and the hypolimnion (lower layer) has ***not significantly changed*** (either *increased* or *decreased*) since monitoring began. Specifically, the epilimnetic phosphorus concentration has ***fluctuated between approximately 1 and 12.5 ug/L,*** and the hypolimnetic phosphorus concentration has ***fluctuated between approximately 9 and 56 ug/L*** since **1987**. Please note that this deep spot was not sampled for phosphorus during 1999 or 2004, therefore, it was not possible to conduct a formal regression analysis of the historic transparency data. After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and the recreational, economical, and ecological value of lakes and ponds. Phosphorus sources within a lake or pond’s watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**
  Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the lake. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample.

  Three Island Deep Spot
  The dominant phytoplankton species observed in the **August 19th** sample were ***Chrysosphaerella*** **(golden-brown),** ***Aphanizomenon*** **(cyanobacteria),** and ***Rhizosolenia*** **(diatom).**

  Pot Island Deep Spot
  The dominant phytoplankton species observed in the **August 19th** sample were ***Chrysosphaerella*** **(golden-brown),** ***Aphanizomenon*** **(cyanobacteria),** and ***Rhizosolenia*** **(diatom).**

  Mohawk Island Deep Spot
  The dominant phytoplankton species observed in the **September 1st** sample were ***Chrysosphaerella*** **(golden-brown),** ***Tabellaria*** **(diatom),** and ***Mallomonas*** **(golden-brown).**

  Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

- **Table 2: Cyanobacteria**
  In addition to the cyanobacteria ***Aphanizomenon*** being one of the **most-dominant** phytoplankton species in the **August 19th Three Island** and **Pot Island** deep spot samples, a small amount of the cyanobacteria ***Anabaena*** was observed in the **August 19th Three Island** and **Pot Island** deep spot samples. In addition, a small amount of the cyanobacteria ***Microcystis*** was observed in the **September 1st** sample collected at the **Mohawk Island** deep spot. ***These species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.*** (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding cyanobacteria).

  Cyanobacteria can reach nuisance levels when phosphorus loading from the watershed to surface waters is increased (this is often caused by rain events) and favorable environmental conditions occur (such as a period of sunny, warm weather).

The presence of cyanobacteria serves as a reminder of the lake's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading to the lake by eliminating fertilizer use on lawns, keeping the lake shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the lake. If a fall bloom occurs, please collect a sample (any clean jar or bottle will be suitable) and contact the VLAP Coordinator.

- **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The pH at the deep spot this season ranged from **6.60** in the hypolimnion to **7.18** in the epilimnion at the **Three Island** deep spot, ranged from **6.50** in the hypolimnion to **7.07** in the epilimnion at the **Pot Island** deep spot, and ranged from **6.40** in the hypolimnion to **7.00** in the epilimnion at the **Mohawk Island** deep spot. This data indicates that the water is ***slightly acidic*** near the lake bottom and ***approximately neutral*** near the lake surface.

It is important to point out that the pH in the hypolimnion (lower layer) was ***lower (more acidic)*** than in the epilimnion (upper layer). This increase in acidity near the lake bottom is likely due the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the presence of granite bedrock in the state and acid deposition (from snowmelt, rainfall, and atmospheric particulates) in New Hampshire, there is not much that can be done to effectively increase lake pH.

- **Table 5: Acid Neutralizing Capacity**

  Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the lake has been monitored through VLAP.

  Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) at the three deep spots ranged from **6.9** to **7.9 mg/L** this season, which is ***greater than*** the state median. In addition, this indicates that the lake is ***moderately vulnerable*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**

  Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current (which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column). The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The epilimnetic conductivity at the **Three Island** deep spot was **95.73,** at the **Pot Island** deep spot was **93.1 uMhos/cm**, and at the **Mohawk Island** deep spot was **96.74 uMhos/cm,** both of which are ***greater than*** the state mean.

  The conductivity has ***increased*** in the lake and the inlet tributaries since monitoring began. Typically, sources of increased conductivity are due to human activity. These activities include septic systems, agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron and manganese deposits in bedrock, can influence conductivity.

We also recommend that your monitoring group conduct a shoreline conductivity survey of the lake and the tributaries with ***elevated*** conductivity to help pinpoint the sources of conductivity.

To learn how to conduct a shoreline or tributary conductivity survey, please refer to the 2004 "Special Topic Article" or contact the VLAP Coordinator.

It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the lake. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

Therefore, we recommend that the **epilimnion** (upper layer) be sampled for chloride next season. We also recommend that your monitoring group sample the major inlets to lake to determine the conductivity and chloride levels of the streamflow. This sampling may help us pinpoint what areas of the watershed which are contributing to the increasing in-lake conductivity.

Please note that there will be an additional cost for each of the chloride samples and that these samples must be analyzed at the DES laboratory in Concord. In addition, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.

Furthermore, we recommend that the associations work with watershed residents to reduce the use of salt on private roads, driveways, and walkways. Watershed residents should be encouraged to implement a "low salt diet" for their property. For guidance, please read the 2005 DES Greenworks Article "Salt: An Emerging Issue for Water Quality" (January 2005) which can be accessed at www.des.nh.gov/gw0105.htm or from the VLAP Coordinator.

- **Table 8: Total Phosphorus**

  Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  A ***limited amount*** of tributary sampling was conducted this season; **Collins Brook** and **Mill Brook** were sampled **once**, and the

Winnipesaukee River and **Black Brook** were sampled **twice**. The phosphorus results in each of these samples was ***relatively low* (14ug/L, or less),** which is good news for the lake.

However, we recommend that three monitoring groups coordinate sampling efforts so that the major tributaries throughout the watershed are sampled on a routine basis during the spring and summer, and periodically during storm events throughout the year.

For a detailed explanation on how to conduct rain event sampling, please refer to the 2002 VLAP Annual Report "Special Topic Article" or contact the VLAP Coordinator.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**
  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2005 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was greater than **100%** saturation at **7 meters** at the **Three Island** deep spot and at **8 meters** at the **Pot Island** deep spot on the **August 19th** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also increase the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Considering that the depth of the photic zone (depth to which sunlight can penetrate into the water column) was approximately **7.5 meters** at the **Three Island** deep spot and **8 meters** at the **Pot Island** deep spot (as shown by the Secchi Disk transparency) we suspect that an abundance of algae in the metalimnion caused the oxygen super saturation.

  The dissolved oxygen concentration was ***relatively high*** at all deep spot depths sampled at the **Three Island** and **Pot Island** deep spot on the **August 19th** sampling event. As thermally stratified lakes age, and as the summer progresses, oxygen typically becomes ***depleted*** in the hypolimnion (lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological oxidation of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake where the water meets the sediment.

The dissolved oxygen concentration was ***lower in the hypolimnion (lower layer) than in the epilimnion (upper layer)*** at the **Mohawk Island** deep spot of the lake on the **September 1st** sampling event. As stratified lakes age, and as the summer progresses, oxygen typically becomes ***depleted*** in the hypolimnion by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion **(as it was this season and in past seasons at the Mohawk Island deep spot),** the phosphorus that is normally bound up in the sediment may be re-released into the water column (a process referred to as ***internal phosphorus loading***).

- **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

As discussed previously, the turbidity of the **Mohawk Island** deep spot hypolimnetic sample was ***elevated*** **(2.02 NTUs)** on the **September** sampling event. This suggests that the lake bottom was disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed. When the lake bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

The turbidity in the **Black Brook** sample collected in **August** was slightly ***elevated*** (**2.17 NTUs**) which suggests that the stream bottom may have been disturbed while sampling or that erosion is occurring in this portion of the watershed.

When the stream bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting samples in the inlets, please be sure to sample where the stream is flowing and where the stream is deep enough to collect a "clean" sample.

If you suspect that erosion is occurring in this portion of the watershed, we recommend that your monitoring group conduct a stream survey and storm event sampling along this inlet. This additional sampling may allow us to determine what is causing the ***elevated*** levels of turbidity.

For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article" or contact the VLAP Coordinator.

- **Table 12: Bacteria (*E.coli*)**

  Table 12 lists only the historical data for bacteria *(E.coli*) testing. (Please note that Table 12 now lists the maximum and minimum results for all past sampling seasons.) *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms **MAY** also be present.

  Bacteria sampling was not conducted this year. If residents are concerned about sources of bacteria such as failing septic systems, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high, when beach use is heavy, or immediately after rain events.

- **Table 14: Current Year Biological and Chemical Raw Data**

  This table lists the most current sampling season results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year "raw" (meaning unprocessed) data. The results are sorted by station, depth zone (epilimnion, metalimnion, and hypolimnion) and parameter.

- **Table 15: Station Table**

  As of the Spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past (and are most familiar with), an EMD station name also exists for each VLAP sampling location. For each station sampled at your lake, Table 15 identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

DATA QUALITY ASSURANCE AND CONTROL

Sample Receipt Checklist:

Each time the **THREE ISLAND** monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that this monitoring group did an ***excellent*** job when collecting samples and submitting them to the laboratory this season! Specifically, the proper field sampling procedures were followed and there was no need to rejected samples. Keep up the good work!

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, NHDES Fact Sheet ARD-32, (603) 271-2975 or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, NHDES Booklet WD-03-42, (603) 271-2975.

Best Management Practices for Well Drilling Operations, NHDES Fact Sheet WD-WSEB-21-4, (603) 271-2975 or www.des.nh.gov/factsheets/ws/ws-21-4.htm.

Canada Geese Facts and Management Options, NHDES Fact Sheet BB-53, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-53.htm.

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